PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-106594

(43)Date of publication of application : 24.04.1998

(51)Int.Cl. H01M 8/02
H01M 8/10

(21)Application number : 09-197174

(22)Date of filing : 23.07.1997

(71)Applicant : AISIN SEIKI CO LTD

(72)Inventor : KURITA KENJI
KAJIO KATSUHIRO

(30)Priority

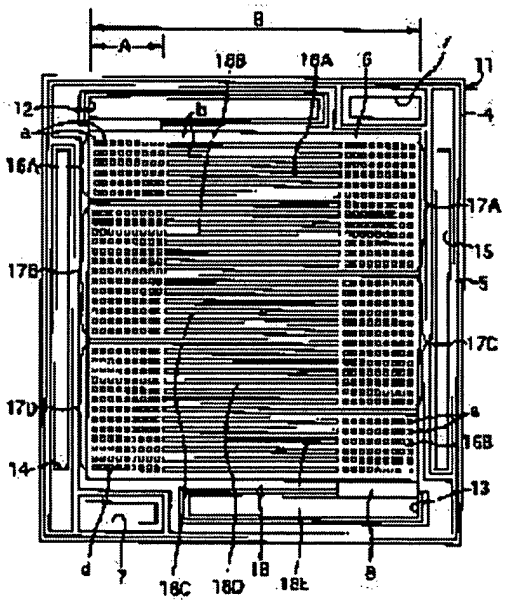
Priority number : 08210235 Priority date : 08.08.1996 Priority country : JP

(54) GAS PASSAGE PLATE OF FUEL CELL

(57)Abstract:

PROBLEM TO BE SOLVED: To enhance the used gas efficiency and the output performance by improving the gas passage in a plate between unit cells constituting a fuel cell.

SOLUTION: A gas flow groove to be provided in the area to a gas diffusion electrode is composed of an inlet side flow groove 16A for supply gas and an output side flow groove 16B which are arranged in a lattice form and an intermediate flow groove 18 in communication from the inlet groove 16A to output groove 16B is folded pluralities to generate a plurality of groups of independent passages 18A-18E wherein the folded-back parts of these independent passage groups are made lattice-form grooves 17A-17D.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] It is the gas-passageway board of a couple with which a conduction slot which leads distributed gas which consists of fuel gas or oxidation gas to an outlet side from each entrance side was formed in a field of this solid electrolyte film of a gas diffusion electrode of a couple which pinches a solid electrolyte film, and this gas diffusion electrode of a couple facing in opposite directions. Said conduction slot of one [at least] of said gas-passageway board It consists of an entrance-side conduction slot located in this entrance side, an outlet side conduction slot located in this outlet side, and a medium conduction slot located among them. It is the gas-passageway board of a fuel cell characterized by for this entrance-side conduction slot and this outlet side conduction slot serving as a grid-like slot, and this medium slot serving as an independent path slot which at least the part runs to parallel of two or more.
[Claim 2] Said medium conduction slot is the gas-passageway board of a fuel cell according to claim 1 characterized by consisting of a part for a bay prolonged in an other end side from an end side, and the curvilinear section turned up by each one end.
[Claim 3] It is the gas-passageway board of a fuel cell of any one publication of claim 2 characterized by for the amount of [of said medium conduction slot] bay becoming said independent path slot, and said curvilinear section serving as a grid-like slot.
[Claim 4] For said medium conduction slot, a side near an outlet side conduction slot is the gas-passageway board of a fuel cell according to claim 1 with which the total path cross section is narrowed.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the gas-passageway board of a solid-state polyelectrolyte mold fuel cell.
[0002]
[Description of the Prior Art] The structure of this kind of fuel cell makes it put each other's gas diffusion electrode which supported the catalyst, respectively on both the principal planes of the solid-state polyelectrolyte film (henceforth a solid electrolyte film) with which ion conductivity was given, and is used as the generation-of-electrical-energy cel. In order to connect this generation-of-electrical-energy cel to a serial and to obtain predetermined voltage, a separator is made to intervene between generation-of-electrical-energy cels, the laminating of two or more generation-of-electrical-energy cels is carried out, and they are stack-ized. In this case, conductivity is given to a separator and the function as a current collection electrode of two diffusion electrodes of those both sides is given.
[0003] If fuel gas and oxidation gas are supplied to the both sides of a separator, respectively and fuel gas and oxidation gas are supplied to each gas diffusion electrode, the ion electric conduction by the solid-state poly membrane and the chemical reaction of each gas diffusion electrode advance, and voltage will occur between the gas diffusion electrodes of a couple, and electric power will be supplied to an external circuit through the separator of the couple by the side of ends with the function of a current collection electrode. In this generation of electrical energy, the rate of gas utilization is decided by how distributed gas is uniformly supplied to the electrode side of a gas diffusion electrode, and generation efficiency and the output engine performance are directly influenced in it.
[0004] However, if distributed gas is supplied all over a gas diffusion electrode, the touch area of a separator and a gas diffusion electrode will be lost, and clearance of the heat generated with efficient current collection and the efficient gas diffusion electrode of the generated current will become difficult. For this reason, the conduction slot which regulates the direction of conduction of distributed gas into the boundary portions of a separator and a gas diffusion electrode was prepared, and the touch area of the existing rate of a separator and a gas diffusion electrode is secured. Usually, hereafter, since the above-mentioned conduction slot is formed in a separator side, also when a gas-passageway board, and a call and a separator are formed in the portion of two or more sheets, it calls [include] a separator a gas-passageway board altogether on these descriptions.
[0005] By the way, in the above-mentioned fuel cell, in order to fully demonstrate the ion conductivity of a solid electrolyte film and to maintain generation efficiency highly, distributed gas (fuel gas and oxidation gas) is humidified, and the steam concentration in distributed gas is raised. Moreover, since a solid-state polyelectrolyte mold fuel cell is what transforms into quantity of electricity the energy of the electrochemical reaction which generates water from hydrogen and oxygen, water generates it to a cathode side (depending on a membranous class, a liquid of a certain kind generates to an anode side).
[0006] For this reason, there is a possibility of the water generated on a reaction containing so much in the downstream, especially an outlet side, being in a liquid condition, and plugging up a gas conduction

slot in the conduction slot of the above-mentioned distributed gas (flooding).
[0007]
[Problem(s) to be Solved by the Invention] in order to avoid beforehand the congestion of the distributed gas by such produced water, various gas-conduction slots are devised from before -- **** (JP,6-215780,A, JP,6-96781,A, JP,6-86730,A, etc.) -- the gas-conduction slot indicated by these official reports divides roughly, and has the gestalt made into one path from the gestalt which it is uniformly dotted with a gas-passageway board, an electrode, and the contact surface, and it consists grid-like of as a gas passageway, the gestalt which a path and the contact surface consist stripe-like of, and an entrance to an outlet.
[0008] Each of these slot gestalten has merits and demerits, and with a grid-like gestalt, a puddle which reaches flooding does not serve as a positive gaseous diffusion configuration and a wastewater configuration, although not generated. while the shape of a stripe be easy structure, a problem be in supply and wastewater nature of gas, with 1 main road gestalt [-izing / a conduction slot / gestalt / 1], by acquire the rate of flow of gas, while diffusibility be good, a pressure loss (passage resistance) need to increase, and it be necessary to make high former ** by the side of a gas transfer unit, and the power income and outgo in a system do not necessarily improve.
[0009] This invention was made in view of the trouble of the above-mentioned conventional technology, and improvement in gaseous diffusion nature and the output engine performance is possible for it, and it makes it the technical problem which should be solved to offer the gas conduction technology which does not apply a burden to a gas transfer unit side.
[0010]
[Means for Solving the Problem]
(Configuration) In order to solve the above-mentioned technical problem, this invention checked that a problem was solvable by forming a grid-like conduction slot in an entrance side and an output side, and opening between each conduction slot of the shape of this grid for free passage in a medium conduction slot which consists of two or more stripe-like independent path groups.
[0011] Namely, a gas-passageway board of a fuel cell of this invention It is the gas-passageway board of a couple with which a conduction slot which leads distributed gas which consists of fuel gas or oxidation gas to an outlet side from each entrance side was formed in a field of this solid electrolyte film of a gas diffusion electrode of a couple which pinches a solid electrolyte film, and this gas diffusion electrode of a couple facing in opposite directions. Said conduction slot of one [at least] of said gas-passageway board It consists of an entrance-side conduction slot located in this entrance side, an outlet side conduction slot located in this outlet side, and a medium conduction slot located among them. It is characterized by for this entrance-side conduction slot and this outlet side conduction slot serving as a grid-like slot, and this medium slot serving as an independent path slot which at least the part runs to parallel of two or more.
[0012] (Operation) In order that an entrance-side conduction slot and an outlet side conduction slot of distributed gas may make the shape of a grid, while a touch area of gas to an electrode becomes large according to the gas-passageway board of a fuel cell of this invention, gas can move freely and an electrode is contacted quickly in time. Therefore, in an entrance-side conduction slot, contacting efficiency (it contacts quickly in time widely in area) of distributed gas and an electrode can avoid loss of gaseous diffusion nature in an entrance side highly. Moreover, in an outlet side conduction slot, loss of the same gaseous diffusion nature as an entrance side is avoidable, and since the path cross section becomes large, wastewater nature can be secured, and flooding can be prevented.
[0013] Moreover, the part being formed by two or more independent path groups, and solving a problem of a pressure loss in 1 main-road gestalt at least, since a gas flow rate speeds up, a medium conduction slot which opens an entrance-side conduction slot and an output side conduction slot for free passage can secure outstanding gaseous diffusion nature at each independent path. Furthermore, that a gas flow rate of a medium conduction slot is quick can feed gas to an output side conduction slot, and it contributes to improvement in wastewater nature.
[0014]

[Embodiment of the Invention] The conduction slot of one [at least] gas-passageway board of the fuel cell of this invention consists of the entrance-side conduction slot located in an entrance side, an outlet side conduction slot located in an outlet side, and a medium conduction slot located among them, this entrance-side conduction slot and this outlet side conduction slot serve as a grid-like slot, and this medium conduction slot serves as an independent path slot which at least the part runs to parallel of two or more. And the entrance-side conduction slot and the output side conduction slot are open for free passage to the entrance manifold and output manifold which were formed in each rim of a gas-passageway board.

[0015] According to the gas-passageway board of such a configuration, the gas introduced into the entrance-side conduction slot moves freely for a grid-like slot, contacts an electrode quickly in time, and raises gaseous diffusion nature. Moreover, the same then area-contacting efficiency also becomes high about the gap between the slots which adjoin the width of face of a medium conduction slot. Since the direction of a firedamp migration is uniformly regulated by the independent path group, gas flows without nonuniformity, and wastewater nature is raised and the rate of flow becomes quick, gas utilization effectiveness of a medium conduction slot also improves. Furthermore, since two or more-izing [the gas passageway], a pressure loss is also reduced.

[0016] The quick gas of the rate of flow is introduced into an outlet side conduction slot, and the good nature of the wastewater nature by the grid configuration and the effect of preventing the congestion of water conjointly become high. Moreover, time and area gas contacting efficiency are raised like an entrance-side conduction slot. The gas-passageway board of the fuel cell of this invention may form the medium conduction slot in two or more diffraction return bay and the curvilinear section. And a pressure loss (passage resistance) can be reduced, maintaining the gaseous diffusion nature in the curvilinear section by using the curvilinear section as a grid-like slot.

[0017] As for the side nearer to an outlet side conduction slot, it is [a medium conduction slot] more desirable that the total path cross section is narrowed. Thereby, the early rate of flow is acquired and gaseous diffusion nature and wastewater nature are made good, so that it is close to an outlet side (downstream).

[0018]

[Example] The gas-passageway board of the fuel cell of this invention is concretely explained with reference to a drawing.

(The 1st example) As shown in drawing 1 and drawing 2 , the pressure welding of the gas-passageway board 11 of the fuel cell with which this invention is applied is carried out to the field of the gas diffusion electrodes 2 and 2 (drawing 2) joined to this solid electrolyte film 1 so that the solid electrolyte film 1 (drawing 2) might be pinched, respectively. each from which each gas-passageway board 11 forces this slot material 6 on these gas diffusion electrodes 2 and 2 in this example in the field of each outside of the slot material 6 in which conduction slot 6a which draws gas along the field of gas diffusion electrodes 2 and 2 was formed, and this slot material 6 -- a metal separator pair -- it consists of 3 and 3 (drawing 2). a metal separator pair -- the periphery enclosure of 3 and 3 adheres to gasket 5a. One generation-of-electrical-energy cel is constituted by these solid electrolyte film 1, the gas diffusion electrodes 2 and 2 of a couple, and the gas-passageway board 11.

[0019] Drawing 1 shows the gas-passageway board 11 by the side of oxidation gas which saw outside the C-C line of drawing 2 . The slot material 6 of this gas-passageway board 11 consists of the carbon or the metals which have gas impermeability and conductivity by the shape of a rectangle corresponding to a gas diffusion electrode 2. It is located in an inner region from the entrance manifold 12 and the outlet manifold 13 which were formed in the rim of said metal separators 3 and 3, oxidation gas flows from this entrance manifold 12, and this gas-passageway board 11 derives the oxidation gas which passed through conduction slot 11a from the outlet manifold 13. An inflow and derivation of fuel gas are performed from the entrance manifold 14 and the output manifold 15 which were formed in the location where the gas-passageway board 11 of fuel gas is also as alternate as the entrance manifold 12 of oxidation gas, and the outlet manifold 13. The entrance manifold 12 of oxidation gas, the outlet manifold 13 and the entrance manifold 14 of fuel gas, and the output manifold 15 are made an

independent gas passageway by the bead 5 pasted up on the gasket 5a (drawing 2) side, and airtightness is held. In addition, each manifold of the path 13 of cooling water is avoided in the rim section of the gas-passageway board 11, and it is formed in it.
[0020] The above-mentioned conduction slot 11a consists of medium conduction slots 18 which opened for free passage entrance-side conduction slot 16A which was directly open for free passage to the entrance manifold 14, outlet side conduction slot 16B which was directly open for free passage to the above-mentioned outlet manifold 15, and above-mentioned entrance-side conduction slot 16A and outlet side conduction slot 16B. Entrance-side conduction slot 16A and outlet side conduction slot 16B are formed in the shape of a grid, and the medium conduction slot 18 is formed in the ups-and-downs gestalt which carried out the multiple-times cuff, and consists of independent path groups 18A-18E prolonged in the shape of two or more straight lines, and grid-like slots 17A-17D formed in the cuff section. That is, fields other than the isolated projection a which entrance-side conduction slot 16A and outlet side conduction slot 16B aligned in all directions, and was formed are gas conduction slots, and fields other than the Choen projection b of the independent path groups 18A-18E are gas conduction slots. Moreover, fields other than the isolated projection d of the grid-like slots 17A-17D on the section are gas conduction slots by return.
[0021] Moreover, as for the ratio of the breadth A of the above-mentioned entrance-side conduction slot 16A, and the whole breadth B, being set as 1:5-6 is desirable. In the above-mentioned example, one distributed gas from the entrance manifold 12 goes into entrance-side conduction slot 16A that there is comparatively no resistance. This is because entrance-side conduction slot 16A is a grid slot, and distributed gas moves grid Mizouchi freely by former ** of a gas transfer unit, and contacts an electrode for a short time. Moreover, when independent path group 18A and the flute width in the following medium conduction slot 18 are made in agreement, the touch area of a grid slot with an electrode increases. Thereby, the electrode activity ratio (gas contacting efficiency) in an entrance side improves.
[0022] In addition, when the ratio of the breadth A of the above-mentioned entrance-side conduction slot 16A and the whole breadth B was set to 1:5-6, it was checked that an electrode activity ratio improves most. The ratio of the breadth of the section or the breadth of outlet side conduction slot 16B may also be made the same by return. In the medium conduction slot 18, while the independent path groups 18A-18E serve as a subject, carry out conduction of the gas without nonuniformity at high speed and improve gas utilization effectiveness, the pressure loss is reduced by two or more-ization of a gas passageway. By return, Sections 17A-17D reduce further passage resistance by the independent path groups 18A-18E, and are effective in maintaining the gaseous diffusion nature in the independent path groups 18A-18E.
[0023] In outlet side conduction slot 16B, while draining the water which stagnates by the quick gas of the rate of flow from the last independent path group 18E, gaseous diffusion nature is improved from the point of the path cross section and time amount like entrance-side conduction slot 16A.
(The 2nd example) Drawing 3 shows slot material 6' of the gas-passageway board of the fuel cell concerning the 2nd example of this invention. As shown in drawing 3 , the side near outlet side conduction slot 22B narrows the total path cross section of the independent path groups [in / in the gas-passageway board of the fuel cell of this example / the medium conduction slot 21] 21A-21E. Although the one 1 path cross section of the independent path groups 21A-21E is the same, more specifically, the side near outlet side conduction slot 22B has reduced the number. namely, drawing 3 -- it is, and if the number of each path of independent path group 21A which opened entrance-side path slot 22A and grid-like slot 23A of the first cuff section for free passage is made into n, 21Bconsists of paths of n-1 independent path group which opened grid-like slot 23A and second grid-like slot 23B for free passage. Similarly, independent path group 21C which opened grid-like slot 23B and third grid-like slot 23C for free passage consists of n-2 paths, and 21Econsists of paths of n-5 independent path slots which opened the last grid-like slot 23D and outlet side conduction slot 22B for free passage like the following.
[0024] Thus, when the downstream reduces **** of the gas passageway passing through the medium conduction slot 21, like the 1st example, when a path number is the same, it compares, and the rate of flow of the gas drawn by outlet side conduction slot 22B can be increased, and much more wastewater

nature in predetermined capacity is realized, without causing buildup of a pressure loss. Next, in each above-mentioned example, as shown in drawing 4 or drawing 5 , into the portion (portion shown in a sign 8 by drawing 1) in which the outlet side conduction slot 13 adjoins the outlet manifold 13, the flow of the gas to the outlet manifold 13 becomes good, and wastewater nature also improves more by form the rib group 19 which forms not the same grid slot as the outlet side conduction slot 13 but a stripe slot long a little in the direction gas turns [direction] to the outlet manifold 13, or 20 The rib 20 of drawing 5 is characterized by forming division slant-face 20A in the flow opposed face of gas.
[0025] The same rib can be formed also in entrance-side conduction slot 16A. Moreover, a gas-passageway board may be manufactured also as an object of a metal separator and one.
[0026]
[Effect of the Invention] As stated above, reduction of the high rate of gas utilization and aisle resistance can be realized in the gas conduction configuration where it excelled in the wastewater nature especially in an outlet side, and the whole gaseous diffusion nature according to this invention, and the output engine performance can be raised.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the plan showing the gas-passageway board of the fuel cell concerning the 1st example of this invention.
[Drawing 2] It is the cross section of the whole fuel cell which applies this invention.
[Drawing 3] It is the plan showing the gas-passageway board of the fuel cell concerning the 2nd example of this invention.
[Drawing 4] It is explanatory drawing showing the modification of the entrance-side conduction slot in this invention, or an outlet side conduction slot.
[Drawing 5] It is explanatory drawing showing other modifications of the entrance-side conduction slot in this invention, or an outlet side conduction slot.
[Description of Notations]
11 -- for an entrance-side conduction slot, and 16B and 22B, an outlet side conduction slot, and 18 and 21 are [an outlet manifold, and 16A and 22A / an independent path group, 17A-17D, and 23A-23D of a medium conduction slot, 18A-18E, and 21A-21E] the grid-like slots on the section by return, and a gas-passageway board, 12 entrance manifold, and 13 give the common sign to the same

---

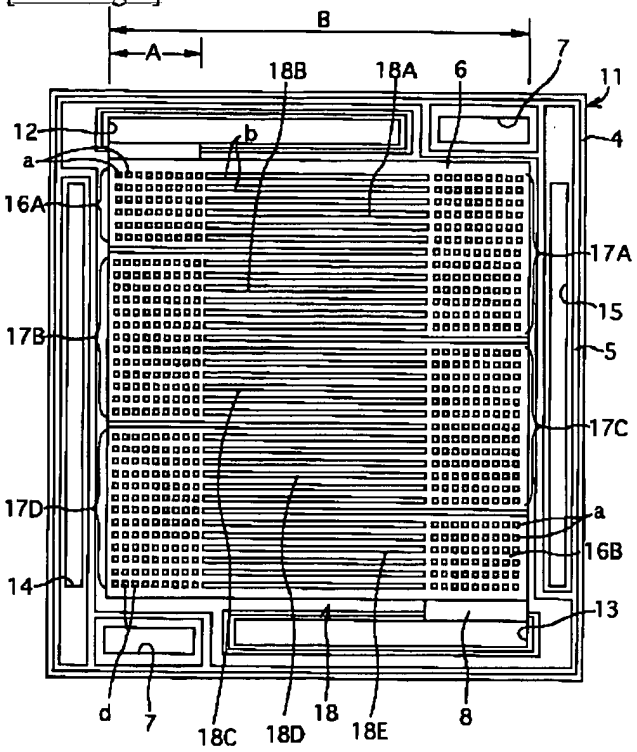
[Translation done.]

* NOTICES *

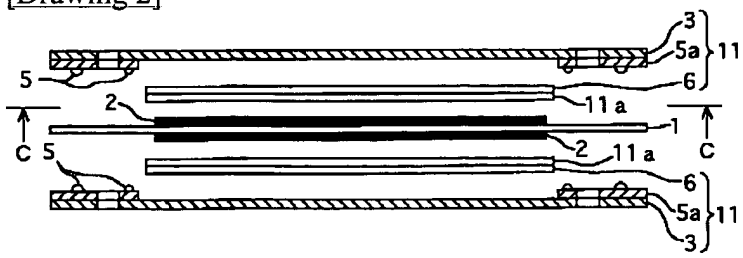
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

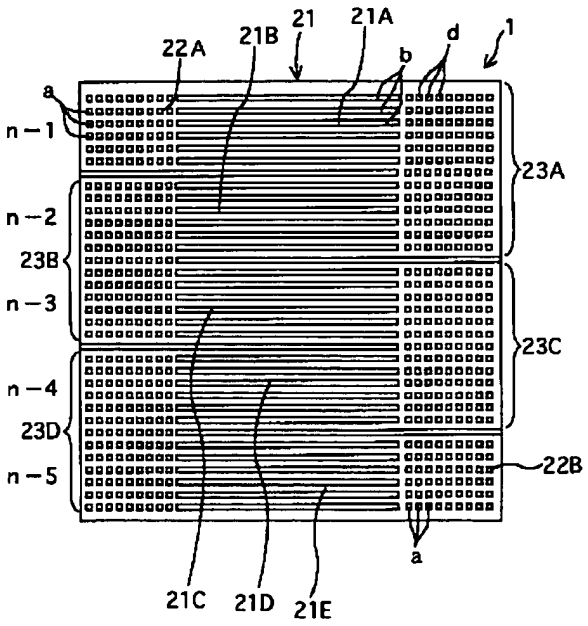
[Drawing 1]



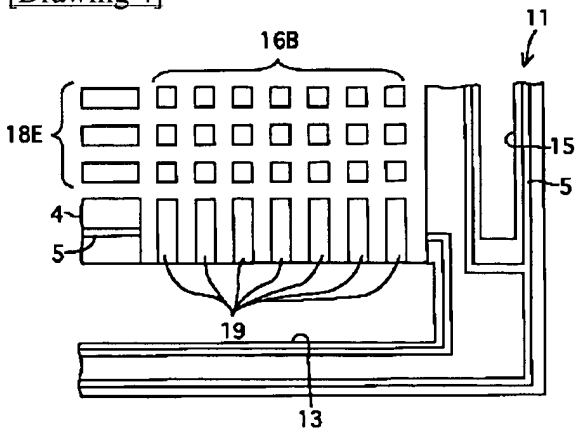
[Drawing 2]



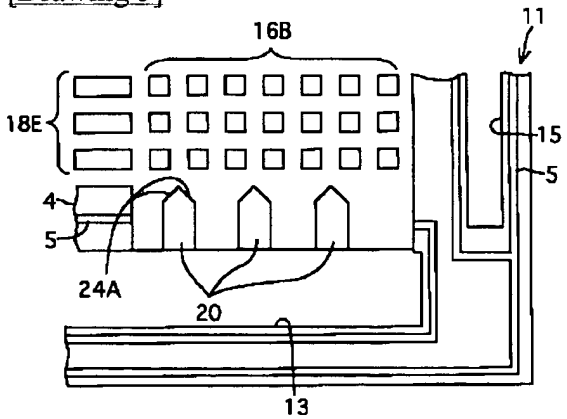
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（A）　(11)特許出願公開番号

特開平10－106594

(43)公開日　平成10年(1998)４月24日

(51)Int.Cl.[6]	識別記号	ＦＩ		
Ｈ０１Ｍ　8/02		Ｈ０１Ｍ　8/02		R
				B
8/10			8/10	

審査請求　未請求　請求項の数４　ＯＬ　（全５頁）

(21)出願番号　特願平9－197174

(22)出願日　平成９年(1997)７月23日

(31)優先権主張番号　特願平8－210235

(32)優先日　平８(1996)８月８日

(33)優先権主張国　日本（ＪＰ）

(71)出願人　000000011
アイシン精機株式会社
愛知県刈谷市朝日町２丁目１番地

(72)発明者　栗田　健志
愛知県刈谷市朝日町２丁目１番地　アイシン精機株式会社内

(72)発明者　梶尾　克宏
愛知県刈谷市朝日町２丁目１番地　アイシン精機株式会社内

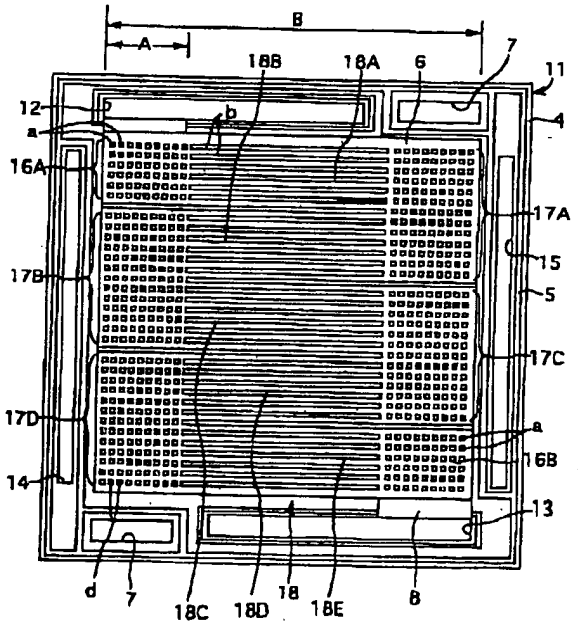
(74)代理人　弁理士　大川　宏

(54)【発明の名称】　燃料電池のガス通路板

(57)【要約】

【課題】　燃料電池のセル間に介装するガス通路板のガス通路の改善によりガス利用効率及び出力性能の向上を図る．

【解決手段】　ガス拡散電極との間に形成するガス通流溝が、供給ガスの入口側通流溝１６Ａ及び出口側通流溝１６Ｂを格子状とし、かつ、該入口側通流溝１６Ａ及び出口側通流溝１６Ｂとを連通する中間通流溝１８を複数回の折返し形状で複数本の独立通路群１８Ａ～１８Ｅ及び該独立通路群同士の折返し部を格子状溝１７Ａ～１７Ｄとした．



【特許請求の範囲】

【請求項1】 固体電解質膜を挟持する一対のガス拡散電極の該固体電解質膜と背向する一対の該ガス拡散電極の面に燃料ガスまたは酸化ガスからなる供給ガスをそれぞれの入口側から出口側に導く通流溝が形成された一対のガス通路板であって、

少なくとも一方の前記ガス通路板の前記通流溝は、該入口側に位置する入口側通流溝部と該出口側に位置する出口側通流溝部とそれらの間に位置する中間通流溝部とからなり、該入口側通流溝部及び該出口側通流溝部は格子状溝となり、該中間溝部はその少なくとも一部が複数本の平行に走る独立通路溝となっていることを特徴とする燃料電池のガス通路板。

【請求項2】 前記中間通流溝部は、一端側から他端側に延びる直線部分と各端側で折り返す曲線部とからなっていることを特徴とする請求項1記載の燃料電池のガス通路板。

【請求項3】 前記中間通流溝部の直線部分は前記独立通路溝となり、前記曲線部は格子状溝となっていることを特徴とする請求項2のいずれか一つに記載の燃料電池のガス通路板。

【請求項4】 前記中間通流溝は、出口側通流溝部に近い側程、総通路断面積が狭められている請求項1記載の燃料電池のガス通路板。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、固体高分子電解質型燃料電池のガス通路板に関する。

【0002】

【従来の技術】この種の燃料電池の構造は、イオン導電性が付与された固体高分子電解質膜（以下、固体電解質膜という）の両主面に触媒を担持したガス拡散電極をそれぞれ重ね合わせて発電セルとしている。この発電セルを直列に接続して所定の電圧を得るため、発電セル間にセパレータを介在させ発電セルを複数個積層してスタック化する。この場合セパレータに導電性を持たせてその両側の2個の拡散電極の集電電極としての機能を持たせている。

【0003】セパレータの両側にそれぞれ燃料ガス及び酸化ガスを供給してそれぞれのガス拡散電極に燃料ガス及び酸化ガスを供給すると、固体高分子膜でのイオン導電と各ガス拡散電極の化学反応が進行して一対のガス拡散電極間に電圧が発生し、集電電極の機能を持つ両端側の一対のセパレータを介して外部回路に給電する。この発電に当たり、供給ガスをいかに均等にガス拡散電極の電極面に供給するかで、ガス利用率が決り、発電効率及び出力性能に直接影響する。

【0004】しかし、ガス拡散電極の全面に供給ガスが供給されるようにすると、セパレータとガス拡散電極との接触面積が無くなり、発生した電流の効率的な集電やガス拡散電極で発生する熱の除去が難しくなる。このため、セパレータとガス拡散電極の境界部分に、供給ガスの通流方向を規制する通流溝が設けられ、セパレータとガス拡散電極とのある割合の接触面積を確保している。通常、上記通流溝部は、セパレータ側に形成されるので、以下、本明細書ではセパレータをガス通路板と呼び、セパレータが複数枚の部分で形成される場合も含め、全てガス通路板と称する。

【0005】ところで、上記燃料電池では、固体電解質膜のイオン導電性を十分に発揮させて発電効率を高く維持するために、供給ガス（燃料ガス及び酸化ガス）を加湿して、供給ガス中の水蒸気濃度を高めている。また、固体高分子電解質型燃料電池は、水素と酸素から水を生成する電気化学反応のエネルギーを電気量に変換するものであるため、カソード側において水が生成する（膜の種類によってはアノード側にある種の液体が生成する）。

【0006】このため、上記供給ガスの通流溝には、反応上生成される水が下流側、特に出口側に多量に含有し、液体状態となってガス通流溝を塞いでしまうおそれがある（フラッディング）。

【0007】

【発明が解決しようとする課題】このような反応生成水による供給ガスの停滞を未然に回避するため従来より種々のガス通流溝が工夫されている（特開平6-215780号公報、特開平6-96781号公報及び特開平6-86730号公報等）が、これらの公報に開示されたガス通流溝は、大別してガス通路板と電極と接触面が一様に点在してガス通路としては格子状となる形態、通路と接触面とがストライプ状となる形態及び入口から出口まで1本の通路とする形態がある。

【0008】これらの溝形態は、いずれも一長一短があり、格子状の形態では、フラッディングに達するような水溜まりは生じないが、積極的なガス拡散形状、排水形状とはなっていない。ストライプ状は構造が簡単の反面、ガスの供給及び排水性に問題があり、通流溝を1本化する1本道形態では、ガスの流速が得られて拡散性が良好である反面、圧損（流路抵抗）が増えてガス供給装置側の元圧を高くする必要があり、システムにおける電力収支は必ずしも向上しない。

【0009】本発明は上記従来技術の問題点に鑑みてなされたもので、ガス拡散性と出力性能の向上が可能で、ガス供給装置側に負担をかけないガス通流技術を提供することを解決すべき課題とする。

【0010】

【課題を解決するための手段】

（構成）上記課題を解決するため、本発明は、入口側及び出力側には格子状の通流溝を形成し、該格子状の各通流溝間をストライプ状の複数の独立通路群からなる中間通流溝で連通することにより、問題が解決できることを

確認した。

【0011】すなわち、本発明の燃料電池のガス通路板は、固体電解質膜を挟持する一対のガス拡散電極の該固体電解質膜と背向する一対の該ガス拡散電極の面に燃料ガスまたは酸化ガスからなる供給ガスをそれぞれの入口側から出口側に導く通流溝が形成された一対のガス通路板であって、少なくとも一方の前記ガス通路板の前記通流溝は、該入口側に位置する入口側通流溝部と該出口側に位置する出口側通流溝部とそれらの間に位置する中間通流溝部とからなり、該入口側通流溝部及び該出口側通流溝部は格子状溝となり、該中間溝部はその少なくとも一部が複数本の平行に走る独立通路溝となっていることを特徴とする。

【0012】（作用）本発明の燃料電池のガス通路板によれば、供給ガスの入口側通流溝部及び出口側通流溝部が格子状をなすため、電極へのガスの接触面積が広くなると共に、ガスが自由に移動でき、時間的に速く電極と接触する。従って、入口側通流溝部では供給ガスと電極との接触効率（面積的に広く及び時間的に速く接触）が高く入口側におけるガス拡散性の損失を回避し得る。また、出口側通流溝部では、入口側と同様のガス拡散性の損失を回避し、かつ通路断面積が広くなるため排水性を確保してフラッディングを防止することができる。

【0013】また、入口側通流溝部と出力側通流溝部とを連通する中間通流溝部は、少なくともその一部が複数本の独立通路群にて形成され、1本道形態における圧損の問題を解決しつつ、各独立通路ではガス流速が速まるため、優れたガス拡散性を確保することができる。更に、中間通流溝部のガス流速が速いことは、出力側通流溝部へガスを圧送でき、排水性の向上に寄与する。

【0014】

【発明の実施の形態】本発明の燃料電池の少なくとも一方のガス通路板の通流溝は、入口側に位置する入口側通流溝部と出口側に位置する出口側通流溝部とそれらの間に位置する中間通流溝部とからなり、該入口側通流溝部及び該出口側通流溝部は格子状溝となり、該中間通流溝部はその少なくとも一部が複数本の平行に走る独立通路溝となっている。そして、入口側通流溝部及び出力側通流溝部は、ガス通路板の各外縁に形成された入口マニホールド及び出力マニホールドに連通している。

【0015】このような構成のガス通路板によれば、入口側通流溝部に導入されたガスは、格子状溝のため自由に移動し時間的に速く電極と接触してガス拡散性を高める。また、中間通流溝部の幅と隣接する溝の間の間隔を同じとすれば、面積的な接触効率も高くなる。中間通流溝部は、その独立通路群によってガスの移動方向を画一的に規制し、ガスがムラなく流れて排水性を高め、かつ、流速が速くなるのでガス利用効率も向上する。更にガス通路が複数本化されているため、圧損も低減される。

【0016】出口側通流溝部には、流速の速いガスが導入され、格子形状による排水性の良好性と相まって水の停滞を防止する効果が高くなる。また、入口側通流溝部と同様に時間的および面積的なガス接触効率を高める。本発明の燃料電池のガス通路板は、その中間通流溝部を複数回折返し直線部と曲線部とで形成してもよい。そして曲線部を格子状溝とすることにより曲線部でのガス拡散性を維持したまま圧損（流路抵抗）を低減させることができる。

【0017】中間通流溝は、出口側通流溝部に近い側程、総通路断面積が狭められていることが好ましい。これにより、出口側（下流側）に近い程、早い流速が得られてガス拡散性と排水性を良好にする。

【0018】

【実施例】本発明の燃料電池のガス通路板を図面を参照して具体的に説明する。

（第1の実施例）本発明が適用される燃料電池のガス通路板11は、図1および図2に示すように、固体電解質膜1（図2）を挟持するように該固体電解質膜1に接合されたガス拡散電極2、2（図2）の面にそれぞれ圧接されるものである。この実施例では、各ガス通路板11は、ガス拡散電極2，2の面に沿ってガスを導く通流溝6aが形成された溝部材6と、該溝部材6のそれぞれの外側の面に該溝部材6を該ガス拡散電極2、2に押付けるそれぞれ金属セパレータ対3、3（図2）とから構成されている。金属セパレータ対3、3の外周囲にはガスケット5aが付着されている。これら固体電解質膜1、一対のガス拡散電極2，2、ガス通路板11によって一つの発電セルが構成される。

【0019】図1は図2のC－C線より外側を見た例えば酸化ガス側のガス通路板11を示す。該ガス通路板11の溝部材6は、ガス拡散電極2に対応した方形状でガス不透過性と導電性を有する、カーボン若しくは金属より構成される。該ガス通路板11は、前記金属セパレータ3，3の外縁に形成された入口マニホールド12および出口マニホールド13より内域に位置し、該入口マニホールド12から酸化ガスが流入され、通流溝11aを経た酸化ガスを出口マニホールド13より導出する。燃料ガスのガス通路板11も酸化ガスの入口マニホールド12および出口マニホールド13と互違いの位置に形成された入口マニホールド14及び出力マニホールド15より燃料ガスの流入と導出が行われる。酸化ガスの入口マニホールド12および出口マニホールド13と燃料ガスの入口マニホールド14および出力マニホールド15は、ガスケット5a（図2）面に接着されたビード5によって独立のガス通路とされ、かつ気密性が保持される。なお、ガス通路板11の外縁部には、冷却水の通路13もの各マニホールドを避けて形成される。

【0020】上記通流溝11aは、入口マニホールド14に直接に連通した入口側通流溝16Aと、上記出口マ

ニホールド15に直接に連通した出口側通流溝16Bと、上記入口側通流溝16A及び出口側通流溝16Bとを連通した中間通流溝18とから構成されている。入口側通流溝16Aと出口側通流溝16Bとは格子状に形成され、中間通流溝18は、複数回折返した曲折形態に形成され、複数本の直線状に延びる独立通路群18A～18Eと、折返し部に形成された格子状溝17A～17Dとから構成されている。すなわち、入口側通流溝16Aと出口側通流溝16Bは、縦横に整列して形成された孤立突起a以外の領域がガス通流溝であり、独立通路群18A～18Eは長延突起b以外の領域がガス通流溝である。また、折返し部の格子状溝17A～17Dは、孤立突起d以外の領域がガス通流溝である。

【0021】また、上記入口側通流溝16Aの横幅Aと全体横幅Bとの比は、1：5～6に設定されることが好ましい。上記実施例において、入口マニホールド12からの一方の供給ガスは、比較的抵抗無く入口側通流溝16Aに入る。これは入口側通流溝16Aが格子溝のためであり、供給ガスはガス供給装置の元圧により自由に格子溝内を移動して短時間で電極と接触する。また、格子溝は、後に続く中間通流溝18における独立通路群18Aと溝幅を一致させた場合、電極との接触面積が多くなる。これにより、入口側における電極使用率（ガス接触効率）が向上する。

【0022】なお、上記入口側通流溝16Aの横幅Aと全体横幅Bとの比を1：5～6にすると、最も電極使用率が向上することが確認された。折返し部の横幅や出口側通流溝16Bの横幅の比も同様にしてもよい。中間通流溝18では、独立通路群18A～18Eが主体となってガスを高速でムラなく通流させガス利用効率を向上するとともに、ガス通路の複数本化により圧損を低減している。折返し部17A～17Dは、独立通路群18A～18Eでの流路抵抗を更に低減して、独立通路群18A～18Eでのガス拡散性を維持させる効果がある。

【0023】出口側通流溝16Bにおいては、最終の独立通路群18Eからの流速の速いガスで停滞する水を排水するとともに、入口側通流溝16Aと同様に通路断面積と時間の点よりガス拡散性を向上する。

（第2実施例）図3は本発明の第2実施例に係る燃料電池のガス通路板の溝部材6′を示す。図3に示すように、この実施例の燃料電池のガス通路板は、中間通流溝21における独立通路群21A～21Eの総通路断面積を、出口側通流溝22Bに近い側程、狭めたものである。具体的には、独立通路群21A～21Eの一本一本の通路断面積は同じであるが、本数を出口側通流溝22Bに近い側程、減じている。すなわち、図3おいて、入口側通路溝22Aと最初の折返し部の格子状溝23Aとを連通した独立通路群21Aの各通路の本数をn本とすると、格子状溝23Aと二番目の格子状溝23Bとを連通した独立通路群21Bはn－1本の通路から構成されている。同様に、格子状溝23Bと三番目の格子状溝23Cとを連通した独立通路群21Cはn－2本の通路から構成され、以下同様に、最終の格子状溝23Dと出口側通流溝22Bとを連通した独立通路溝21Eはn－5本の通路から構成されている。

【0024】このように中間通流溝21を通るガス通路の本通を下流側程、減じることにより、第1実施例のように通路本数が同じの場合に比し、出口側通流溝22Bに導出されるガスの流速を増大でき、圧損の増大を招かずに所定ガス量での一層の排水性が実現する。次に上記各実施例において、図4或は図5に示すように、出口側通流溝13が出口マニホールド13に隣接する部分（図1で符号8に示す部分）に、出口側通流溝13と同じ格子溝でなく、ガスが出口マニホールド13に向く方向に若干長いストライプ溝を形成するリブ群19或は20を形成することで、出口マニホールド13へのガスの流れが良好となり、より排水性も向上する。図5のリブ20はガスの流れ対向面に分割斜面20Aが形成されることを特徴とする。

【0025】同様のリブは、入口側通流溝16Aにも形成することができる。また、ガス通路板は金属セパレータと一体の物としても製作されてもよい。

【0026】

【発明の効果】以上述べたように本発明によれば、特に出口側における排水性及び全体のガス拡散性に優れたガス通流形状で、高いガス利用率と通路抵抗の低減を実現し、出力性能を向上させることができる。

【図面の簡単な説明】

【図1】 本発明の第1実施例に係る燃料電池のガス通路板を示す平面図である。

【図2】 本発明を適用する燃料電池全体の断面図である。

【図3】 本発明の第2実施例に係る燃料電池のガス通路板を示す平面図である。

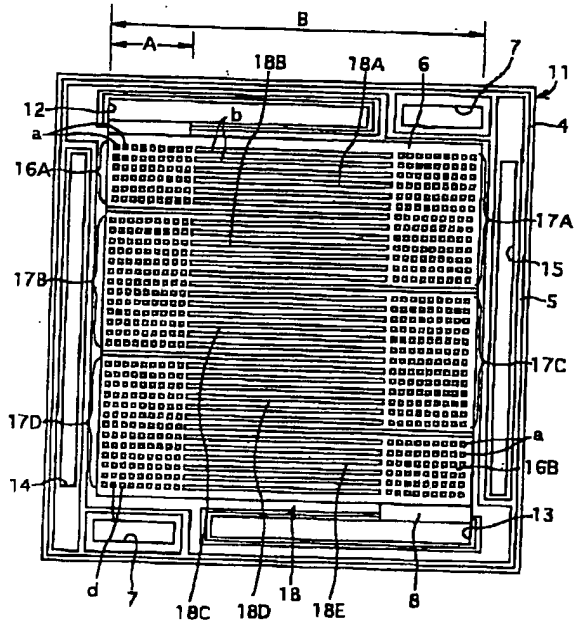
【図4】 本発明における入口側通流溝若しくは出口側通流溝の変形例を示す説明図である。

【図5】 本発明における入口側通流溝若しくは出口側通流溝の他の変形例を示す説明図である。

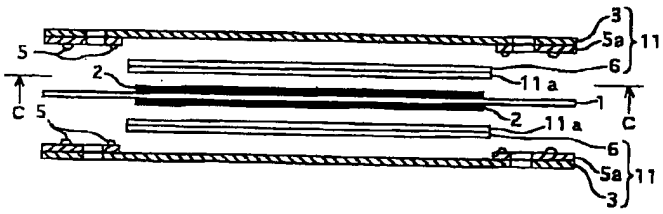
【符号の説明】

11はガス通路板、12入口マニホールド、13は出口マニホールド、16A、22Aは入口側通流溝、16B、22Bは出口側通流溝、18、21は中間通流溝、18A～18E、21A～21Eは独立通路群、17A～17D、23A～23Dは折返し部の格子状溝であり、各部において同一要素には共通符号を付している。

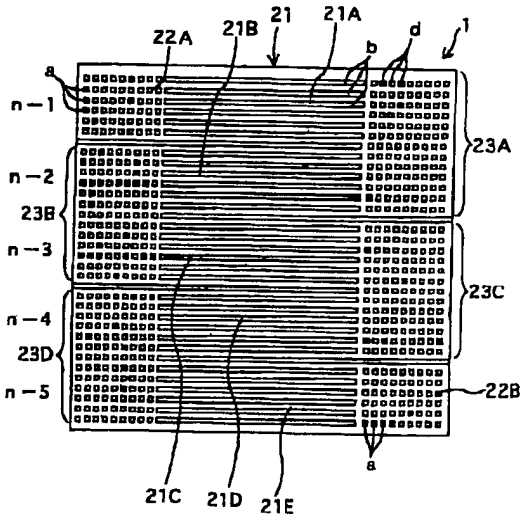
【図1】


B
A
18B
18A
6
7
11
12
b
a
4
16A
17A
15
17B
5
17C
17D
a
16B
14
13
d
7
18C
18D
18
18E
8

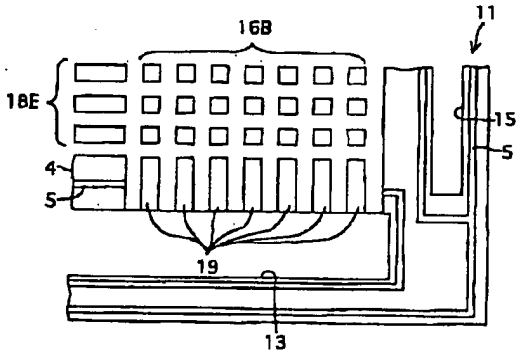
【図2】


3
5a
11
5
6
2
11a
1
C
5
C
2
11a
6
5a
11
3

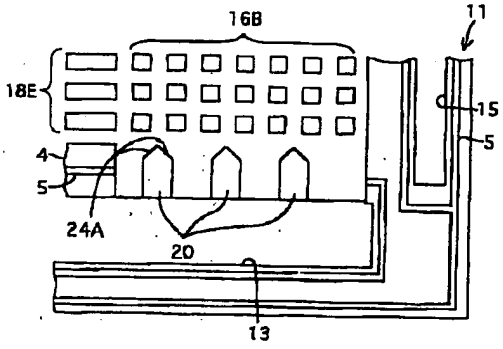
【図3】


22A
21B
21
21A
b
d
1
a
n-1
23A
n-2
23B
n-3
23C
n-4
23D
n-5
22B
a
21C
21D
21E

【図4】


16B
11
18E
15
5
4
5
19
13

【図5】


16B
11
18E
15
5
4
5
24A
20
13